

Project ID #09381 - Modular Design of High Temp Recuperator Using 3D Printing Technology leads to reduced use of high temperature alloys for future CSP plants

1. Impact

The modular design concept effectively using high temperature nickel alloys provides an alternative and potential cost reduction to the printed circuit heat exchangers (PCHE). By leveraging the rapid advancement of AM technologies and combining Directed Energy Deposition (DED) and Laser-Power Bed Fusion (L-PBF), the modular design can significantly reduce the manufacturing cost of high-temperature heat exchangers such as the high temperature recuperator (HTR) in a sCO₂ Brayton cycles, enabling CSP plants to reach the LCOE goal of \$0.05/kWh by 2030.

2. Project Goal

This SIPS project will approve or disapprove the feasibility of using AM technologies to support the modular design concept using dissimilar metals for high-temperature heat exchangers. Specifically, the goal is to fabricate functionally graded material (FGM) with complex geometries such as flow channels using DED and L-PBF to demonstrate the modular design concept in achieving high-performance and low-cost HTR.

3. Method(s)

Step 1 – Establish the mechanical properties of each single material for respective AM process
Step 2 – Develop the FGMs and feature sizes
Step 3 – Design and analyze the modular HTR
Step 4 – Print the modular HTR and pressure test

4. Outcome(s)

SS 316L test samples have been printed by L-PBF
Inconel 625 samples have been printed by DED
Preliminary printable design of the modular, bi-metal HTR using L-PBF and DED is completed

5. Conclusion/Risks

The next step is to confirm mechanical properties of the test samples as printed; optimize the transition strategies for different nickel alloys; refine the design after further performance analysis and process validation

6. Team

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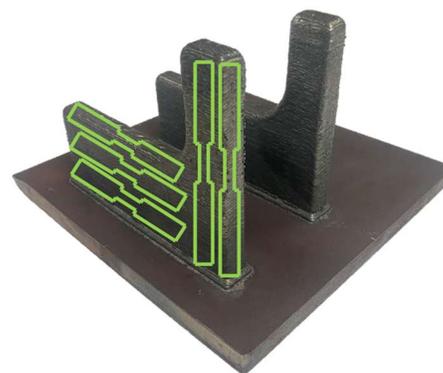
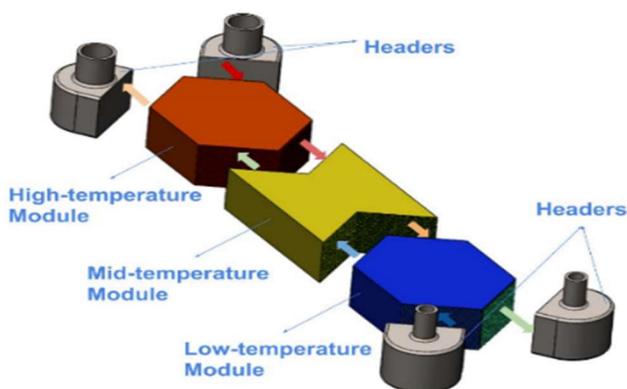


Figure 1. The modular design concept using ss316 and nickel alloys leveraging DED for fabricating FGM